Name Date Class

SECTION 4 Enrichment

Searching for the Age of the Universe

In spite of the development of the Hubble space telescope and the building of two space stations, scientists still are no closer to agreeing on one of the central questions of astronomy: How old is the universe? From time to time, announcements are made by different research teams who think they have found the answer, but soon there is always a great deal of disagreement from other research teams. Astronomers might not yet be able to definitively state the age of the universe, but they have identified several clues that might one day settle the question.

How old are you now?

What types of clues tell about the age of the universe? One key to estimating age is to estimate distance. Because many scientists believe the universe began with the Big Bang and is continuing to expand, measuring distance can give researchers a relative idea of how old objects in space are. However, because no one knows for sure whether the rate of expansion is increasing or decreasing, measurement methods vary. The Hubble telescope has provided more accurate measurements in some cases, but results about the age of the universe based on an eight-year study are still considered controversial. That study stated that the universe is around 12 billion years old. A later NASA study also used the Hubble telescope. This study looked in one galaxy at *Cepheid variables,* which emit light in pulses. The rate of pulsation is related to the brightness of the variables, and so by measuring the brightness of the galaxy, researchers can calculate how far it is from Earth. This type of measurement, however, is claimed by some to overestimate galaxy distances, significantly throwing off calculations of the age of the universe.

The Oldest Stars in the Galaxy

Yet another study used *masers* for its measurements. Masers are the microwave version of lasers. They are located near an apparent black hole near the center of the universe. Another clue to the age of the beginning of the universe might lie in star clusters. In the Milky Way there are clusters of stars thought to have formed just after the Big Bang, making them the oldest stars in the galaxy. The groupings of these stars are called globular clusters. In this case, scientists study white dwarf stars in a cluster and calculate the mass and temperature of the stars. These calculations allow scientists to determine the distance and, therefore, the age of the cluster. Since these are the oldest stars, knowing their age can help researchers calculate the age of the universe. However, because no one has yet proved results to be infallible, the quest for discovering the age of the universe continues.

1. Why does measuring distance help scientists measure the age of stars?

_____

2. Why are these measurements controversial?

_____

_____

3. What are two methods scientists have used to try to determine the age of the universe?

_____

_____

Meeting Individual Needs

The Milky Way

Use with Chapter 31
Section 31.1

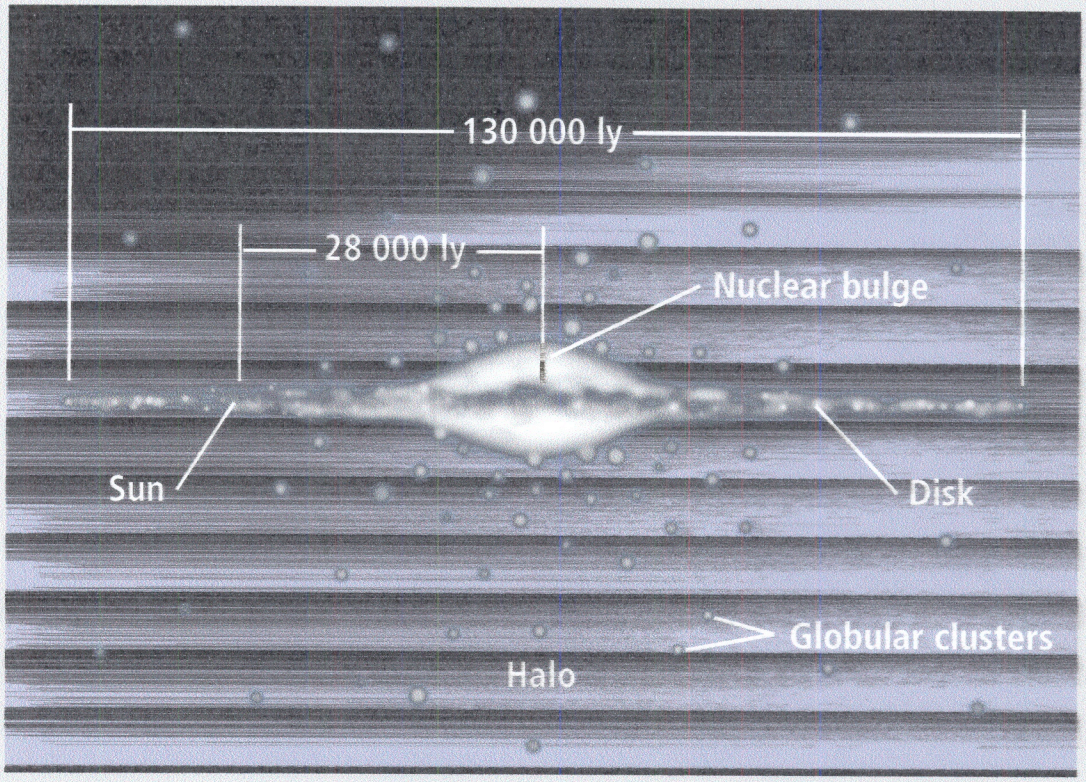

Figure is not to scale.

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Name _____ Class _____ Date _____

WORKSHEET 94 TEACHING TRANSPARENCY

Use with Chapter 31
Section 31.1

The Milky Way

1. What are the galactic center and nuclear bulge?

2. What is the halo?

3. Approximately how far is the Sun from the galactic center?

4. Approximately how large is the Milky Way galaxy?

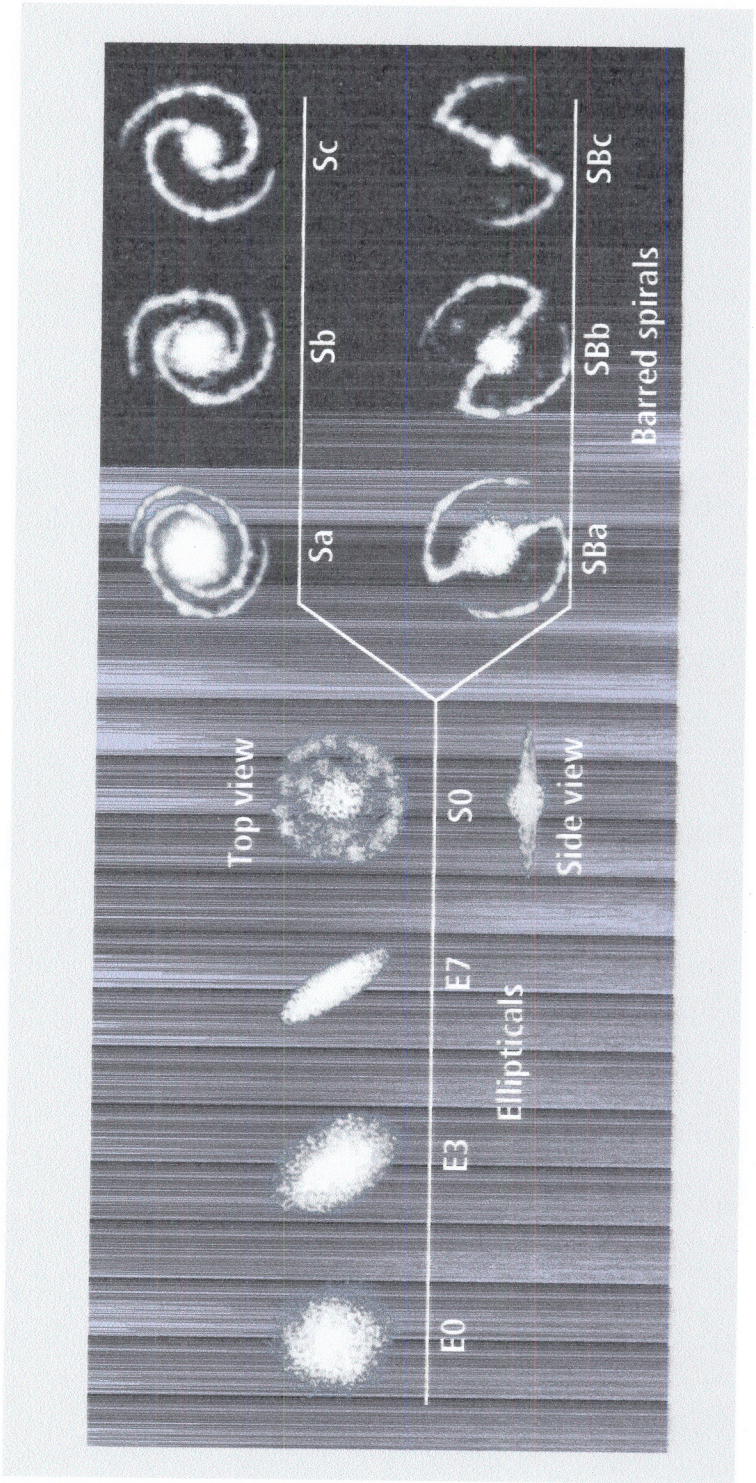
5. Describe the shape of the Milky Way galaxy.

6. Why can't astronomers be certain of the shape of the Milky Way?

7. How many major arms does the galaxy have?

Use with Chapter 31
Section 31.2

Galaxy Classification



Use with Chapter 31
Section 31.2

Galaxy Classification

1. How are spiral galaxies and elliptical galaxies different?

2. What do the letters *a*, *b*, and *c* indicate in reference to spiral galaxies?

3. What do the numbers represent in the classification of elliptical galaxies?

4. What is the shape of a galaxy that has the classification *S0*?

5. What are the two classifications for spiral galaxies, and how do they differ?

6. How might the Milky Way galaxy be classified? Why is its classification uncertain?

7. How are galaxies that are neither spiral nor elliptical classified? Give an example of this type of galaxy.

Name Date Class

SECTION 2 Enrichment

Spacesuits

Humans cannot travel outside a spaceship without protection. They must be protected from the extreme cold of space and the lack of air pressure. The condition of weightlessness combined with a lack of atmospheric pressure places the human body in a life-threatening position. One of the most dangerous problems humans encounter in space, however, is the exposure to high levels of radiation streaming from the Sun. The Sun produces many types of radiation including gamma rays and X-rays.

Barriers to Radiation

Normally, the atmosphere of Earth protects us from most of the Sun's radiation. We receive some degree of ultraviolet light and other forms of high energy waves, but most of these dangerous waves are turned away by the atmosphere and the magnetic field surrounding our planet. In space, however, the human body is exposed to all of the Sun's harmful emissions. Scientists have addressed this dangerous problem by designing super protective spacesuits. These spacesuits are made of special fabrics and act as barriers to most radiation. The unique face masks are coated with resistant chemical barriers and act like huge sunglasses. Even so it is best if astronauts only expose themselves to the Sun's radiation for a few hours.

New Use for Spacesuits

One amazing use for these suits has been discovered right here on Earth. Some children are born with a condition in which they cannot tolerate any light or ultraviolet radiation. This condition is called xeroderma pigmentosum, or XP for short. Children born with this condition cannot tolerate *any* exposure to the Sun. In the past, these children were forced to stay indoors and away from windows or bright lights.

Scientists at the National Aeronautics and Space Administration (NASA) recognized that their astronaut apparel could benefit people with XP. The scientists designed suits for two little girls and in 1999, the children were able to come out into the sunlight for the very first time wearing their special spacesuits. Most spacesuits are white to repel some of the Sun's emissions, but the girls have asked for colors for their special outfits. Don't be surprised if, someday, you see an astronaut wearing a green or yellow spacesuit.

1. What is one of the most dangerous problems for astronauts in space?

2. Why do humans on earth not experience the same problems as astronauts in space?

3. What are two features of spacesuits that help protect astronauts?

4. What other use did NASA find for its spacesuits?

Content Mastery

Section 4 ▪ of Stars Galaxies and the Universe

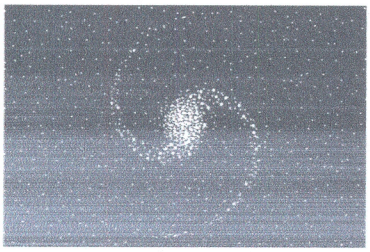
Directions: *Identify the stages in the life cycle of an average star. Use the words below to fill in the blanks.*

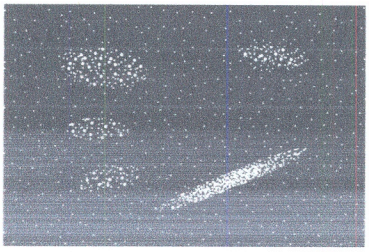
white dwarf **nebula** **giant** **main sequence**

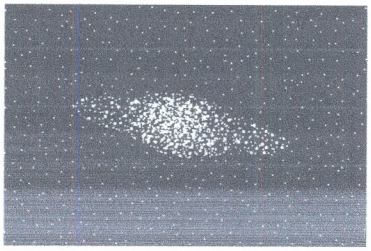
1. Star begins in a clouds of gas and dust. _____
2. Star continues to use hydrogen for energy; heat from fusion causes pressure that balances the pull of gravity. _____
3. Star's core is exhausted of hydrogen; its outer layers expand and cool. _____
4. Star's core is exhausted of helium; its outer layers escape into space leaving only the core; the core contracts, or gets smaller. _____

Directions: *Identify the type of galaxy shown in each illustration. Use the words to fill in the blanks below.*

irregular **spiral** **elliptical**







5. _____ 6. _____ 7. _____

Directions: *Answer the questions below on the lines provided.*

8. In which galaxy is our solar system? _____
9. What is the name for the change in a star's spectrum when it moves away from Earth? _____
10. What is the theory that explains how the universe began with an enormous explosion? _____

_____

Meeting Individual Needs